SYNOPSIS

KEY POINT SUMMARY

OBJECTIVES

This investigation sought to identify a mathematical model that can calculate the required number of bariatric beds in a given hospital.

Determining the number of bariatric beds needed in a U.S. acute care hospital

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Key Concepts/Context

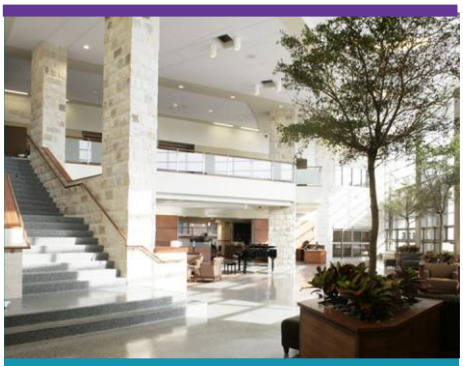
The growing prevalence of obesity in the U.S. creates increased healthcare costs including costs associated with providing care for "patients of size" (> than 300 pounds). Too many bariatric beds are an unnecessary expenditure and too few contribute to negative patient and organizational outcomes. Better understanding of bariatric bed demand can improve operational efficiency. This paper describes a way to determine the optimal number of bariatric beds for a hospital.

Methods

This study used three years of admission and length of stay (LOS) data for 765 patients-of-size (bariatric patients) from a 515-bed urban research and trauma center hospital. Mathematical models were applied to the dataset to create a methodology for estimating demand for bariatric beds. Researchers tested two models: a computer-based simulation that could run the data hundreds of times with numerous variables and a simpler formula-based approximation that used constant arrival times and service times.

A great amount of variability both in number of patients and in LOS makes straightforward forecasting methods difficult. The application of simulation software utilized historic data and modeling capabilities to address the variability and determine how many bariatric beds were needed to achieve a pre-determined service level. Input was the number of beds owned by the hospital. Output was the service level, i.e., the number of bariatric patients treated in a bariatric bed divided by all bariatric patients. Building on that, the cost-optimization simulation assumed a service level of 100%, meaning every bariatric patient will get a bariatric bed through assignment of either a hospital-owned bed or a rental bed.

Not all hospitals have the capability or resources to run sophisticated simulation models. Therefore, the researchers also applied a simplified formula-based approximation model using the Erlang loss formula. This formula uses average arrival rate and average LOS to calculate the number of beds required to achieve



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the required service level. The researchers compared the results of both approaches.

Findings

In the data analyzed, average LOS for bariatric patients was 5.25 days (ranging between zero and 57 days), compared to an average LOS of 4.6 days for all patients in all U.S. hospitals. All simulations showed that the greater the number of beds available the greater the service level for patients of size. The data showed a significant variation in distribution across days of the week for both patient day of arrival and average number of bariatric patients in the hospital on any given day. Because of this fluctuation throughout the week, the need for bariatric beds increases in order to hold the service level constant. Bariatric patient LOS did not vary by day of the week. The cost-optimization simulation illustrated an unconstrained trade-off between purchased beds and rented beds and associated costs for each to reach a 100% service level.

The formula-driven approximation model utilizes the average arrival rate and the average LOS and the number of bariatric beds available to calculate the service level. Alternatively, the equation allows one to indicate the service level and solve for the number of beds. The formula-driven approximation model compared to the simulation model with stationary arrival rate never varied by more than 2%. Compared to the simulation model with nonstationary arrival, the formula-driven approximation model illustrated a higher service level. However, there was never more than a three-bed difference between service levels, and the cost was only about 5% higher. The authors suggest the formula-based approximation model is more accurate than simple forecasting and may be sufficient for determining a distribution of how many beds to own and how many to rent.

Limitations

This study was based on a limited dataset from one hospital. Replication studies and additional studies should be conducted, with careful consideration for the assumptions made in this study. Time variables were only measured in days rather than hours. Given the variation of admission arrival times and other phenomena (such as surgery schedules) a study that takes into account hours rather than days may provide additional insight. The analysis is applicable only to bariatric bed requirements, not bariatric patient room requirements or other bariatric furniture and equipment requirements.

Design Implications

Hospitals are expensive enterprises and any well-developed investigation that helps organizations better understand and allocate costs is valuable. Design and

other resource requirements to meet the needs of bariatric patients can and should be based on data analysis rather than simple forecasting.